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RENESAS

User's Manual

Release-it

ZigBee™-ready
Wireless Network Evaluation Board
Using the 78K0/KF1+ Microcontroller

Hardware Manual

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Date Published June 2005
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CHAPTER 1 INTRODUCTION

RELEASE-IT is an evaluation kit for wireless personal area network using 78K0/KF1+ 8-bit MCU and CC2420 RF transceiver.

1.1 Features

- Hardware is ready to accommodate IEEE 802.15.4/ZigBee compliant wireless personal area network with 8 bit single chip MCU 78K0/KF1+, µPD78F0148HD, and 2.4GHz transceiver CC2420.
- Object code of IEEE 802.15.4 PHY/MAC is included in the kit and possible to utilize as a library.
- 60 Kbytes of Flash EEPROM, available on chip in the 78K0/KF1+ MCU, is programmable from PC via USB connection without any additional Flash programming hardware
- Debugging of the program can be made from PC via USB connection utilizing the debugger included in the kit without any additional debugging hardware.
- The evaluation version of the IAR Embedded Workbench for 78K0/K0S, containing C Compiler, Assembler, Linker and C-SPY Simulator can be downloaded from the IAR webpage http://www.iar.com. The direct link to the webpage to download the evaluation version for 78K0/K0S is:

  http://wwwjobb4.iar.se/Download/SW/?item=EW78K-EVAL

- USB connection can be utilized not only for Flash programming and debugging, but also for user applications and power supply.
- Real time clock is available on the board.
- Two MCU boards and two RF transceiver boards with two antennas are packaged in the kit.
- Two digital input ports, two digital output ports, and three analog input ports are available in the each of the MCU board.
- Two tact switches and one 5-direction tact switch are on board in addition to one hardware reset switch.
- Four green LEDs are available on board.
- Two battery adapters for 006P are included in the kit.

1.2 Hardware Specifications

MCU: µPD78F0148HD x 2
Main Clock: 16 MHz
Real Time Clock: 32.768 KHz
RF Transceiver: Chipcon CC2420, one each on two CC2420EM boards
Please refer to www.chipcon.com for further details

Antenna: Two Titanis made by Gigaant, www.gigaant.com, one each on the CC2420EM board.

Interfaces: USB Mini B
Connector between the MCU board and the CC2420EM RF board
I/O Expansion of two digital input ports, two digital output ports,
and three analog input ports
CNB connector for Temp/Humid sensor, SHT11 made by Sensirion, www.sensirion.com/
A battery connector with an adapter for a 006P battery per board

Power Supply: 5V by USB or 9V (Min. 6.5V) by battery connector

Current consumption: Max. 150mA @5V
Actual consumed current depends on the amount data of
TX and/or RX, and mode settings of the transceiver

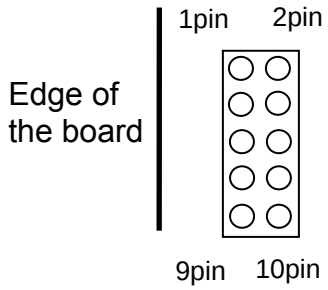
Operation Environment: Temperature: 0 – 40 deg C
Humidity: less than 80 %

Dimension: MCU Board: 70mm x 60mm
RF Board: 40mm x 30mm
Assembled: 80mm x 60mm x 83 mm (H) with an antenna

1.3 Interfaces

I/O Expansion, CN3, HONDA CONNECTORS FFC-10BMEP1

CN3	Name	MCU PIN	Description
1			N.C.
2	P140	P140/PCL/INTP6	Input to MCU with 4.7KΩ Pull-up
3	P10	P10/$\overline{\text{SCK10}}$/TXD0	Output from MCU with 4.7KΩ Pull-up
4	P11	P11/SI10/RXD0	Input to MCU with 4.7KΩ Pull-up
5	GND	GND	
6	P12	P12/SO10	Output from MCU with 4.7KΩ Pull-up
7	P24	P24/ANI4	Analog input to MCU with 1MΩ Pull-up
8	P25	P25/ANI5	Analog input to MCU with 1MΩ Pull-up
9	P26	P26/ANI6	Analog input to MCU with 1MΩ Pull-up
10	GND	GND	



CN3 Pin Configuration

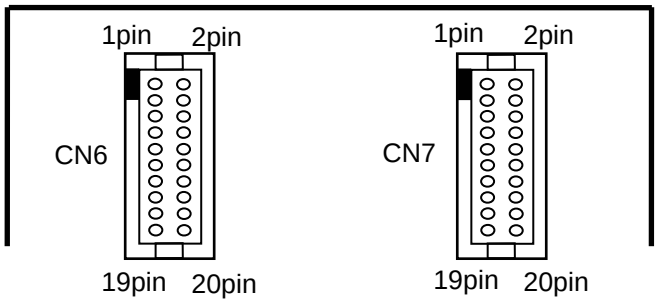
Connector to the RF Board (1/2), CN6, SAMTEC TFM-110-02-S-D-A-K-TR

CN6	Name	MCU Pin	Description
1	GND	GND	
2			N.C.
3	VREG_EN	P02/SO11	Output from MCU
4			N.C.
5	RESn	P03/SI11	Output from MCU
6	FIFO	P33/TI51/TO50/INTP4	Input to MCU
7			N.C.
8	FIFOP	P30/INTP1	Input to MCU
9			N.C.
10	CCA	P62	Input to MCU
11			N.C.
12	SFD	P06/TI011/TO01	Input to MCU
13			N.C.

14	CSn	P145/STB0	Output from MCU
15			N.C.
16	SCLK	P142/$\overline{\text{SCKA0}}$	Output from MCU
17			N.C.
18	SI	P144/SOA0	Output from MCU
19	GND	GND	
20	SO	P143/SIA0	Input to MCU

Connector to the RF Board (2/2), CN7, SAMTEC TFM-110-02-S-D-A-K-TR

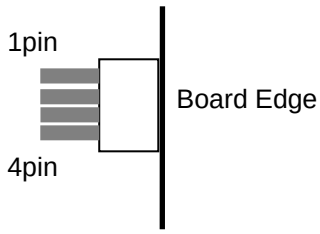
CN6	Name	MCU Pin	Description
1	TP2		
2	GND	GND	
3	TP2		
4	GND	GND	
5	TP2		
6	GND	GND	
7	3.3V		
8	GND	GND	
9	3.3V		
10	GND	GND	
11	TP3		
12	GND	GND	
13	TP4		
14	GND	GND	
15			N.C.
16	GND	GND	
17			N.C.
18	GND	GND	
19			N.C.
20	GND	GND	



PIN Configuration of CN6 and CN7

Connector to Temp/Humid Sensor, CN8, MAC8 HDB-1-1-4P

CN8	Name	MCU Pin	Description
1	SCK	P04/$\overline{SCK11}$	Output from MCU
2	VDD	VDD	5.0V
3	GND	GND	
4	DATA	P05/$\overline{SSI11}$/TI001	Input/Output with MCU



CN8 Pin Configuration

CHAPTER 2 SWITCHES, JUMPERS, AND LEDS

2.1 SW4, SW5, SW7, and JP1

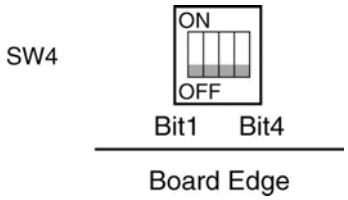
SW4 and SW5 are a DIP switch to select an operation mode.
SW7 is a slide switch to select an operation mode.
JP1 is a jumper to select a power source.

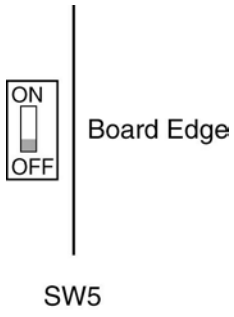
2.1.1 Flash Programming Mode

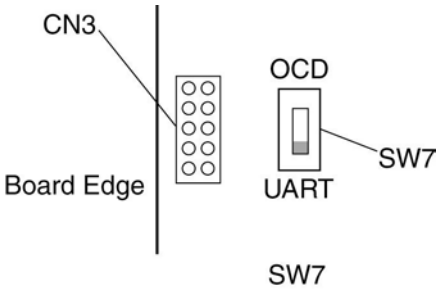
Flash EEPROM on the 78K0/KF1+ MCU can be programmed using the attached software “PG-FPL” in your PC, which is connected to the MCU board via USB cable, if the following switch and jumper setting is made.

Flash Programming Mode

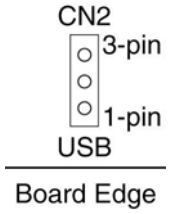
SW4	Bit 1	OFF
	Bit 2	OFF
	Bit 3	OFF
	Bit 4	OFF
SW5		ON
SW7		UART
JP1		USB







SW7



JP1

2.1.2 On-chip Debug Mode

The following setting activates the On-chip debug functions on the MCU. You can debug your program code in the Flash EEPROM, if your PC is connected to the MCU board via USB.

On-chip debug mode

SW4	Bit 1	ON
	Bit 2	ON
	Bit 3	ON
	Bit 4	ON
SW5		ON
SW7		OCD
JP1		USB

2.1.3 Normal Operation Mode

SW4	Bit 1	OFF
	Bit 2	OFF
	Bit 3	OFF
	Bit 4	OFF
SW5		OFF
SW7		UART
JP1		See below

Selection of power source by JP1

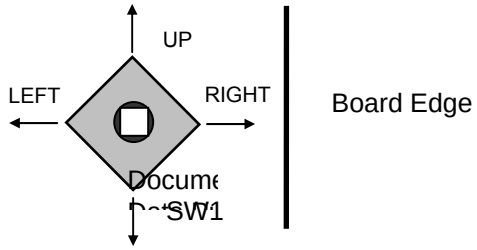
USB Power	USB (Pin 1)
Battery	CN2 (Pin 3)

2.2 SW1

SW1is a 4 directional switch with center push. If it is directed or pushed, the P7*/KR* input is set to GND. Otherwise the circuit is open. Therefore please set the on-chip pull-up resistors at P7*/KR* during initializing routine of your program code. For more detail, please refer to the User's manual of the μPD78F0148HD MCU.

4-directional/center-push switch SW1, ALPS SKRHADE010

SW1	Name	MCU Pin	Description
1	P72	P72/KR2	UP
2	P73	P73/KR3	CENTER PUSH
3	P74	P74/KR4	LEFT
4	P75	P75/KR5	RIGHT
5	GND	GND	
6	P76	P76/KR6	DOWN



2.3 SW2 and SW3

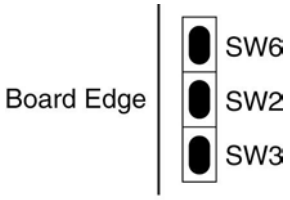
SW2 and SW3 are tact switches. The port inputs are short-circuited to ground, while they are being pushed, and kept open otherwise. Therefore please set the on-chip pull-up resistors at the ports during initializing routine of your program code. For more detail, please refer to the User's manual of the μPD78F0148HD MCU.

Tact switches SW2 and SW3, ALPS SKQMBBE010

	Name	MCU Pin	Description
SW2	P70	P70/KR0	
SW3	P71	P71/KR1	

2.4 SW6

SW6 is the hardware reset.



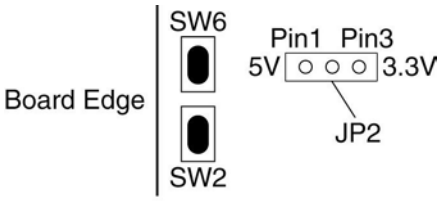
SW2, SW3, and SW6

2.5 JP2

JP2 defines the signal level, 5V or 3.3V, of the I/O expansion, CN3.

JP2 Settings

5.0V	Marked as 5.0V: Pin 1
3.3V	Marked as 3.3V: Pin 3



JP2 Configuration

2.6 LED4

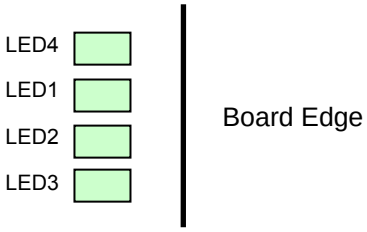
LED4 is the power indicator.

2.7 LED1, LED2, and LED3

LED1, LED2, and LED3 are available for applications. To make an LED on, please set the output port LOW.

LED1, LED2, and LED3: STANLEY ELECTRIC: PG1111C

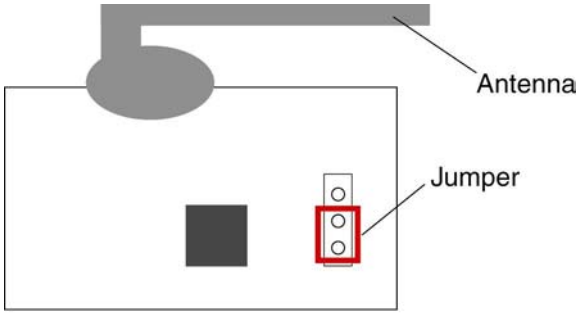
	Name	MCU Pin	Description
LED1	P40	P40/AD0	LED is ON, while P40 is LOW.
LED2	P41	P41/AD1	LED is ON, while P41 is LOW.
LED3	P42	P42/AD2	LED is ON, while P42 is LOW.



LED1, LED2, LED3, and LED4

2.8 Jumper on the CC2420EM board

Please set the jumper on the CC2420EM board as shown in the schematic below. For details of the CC2420EM board, please contact Chipcon AS at www.chipcon.com.



The CC2420EM board

CHAPTER 3 POWER SUPPLY

There are two choices to supply power to the board, USB or a 006P battery via CN2. Please refer to 2.1.3 JP1 for the jumper setting.

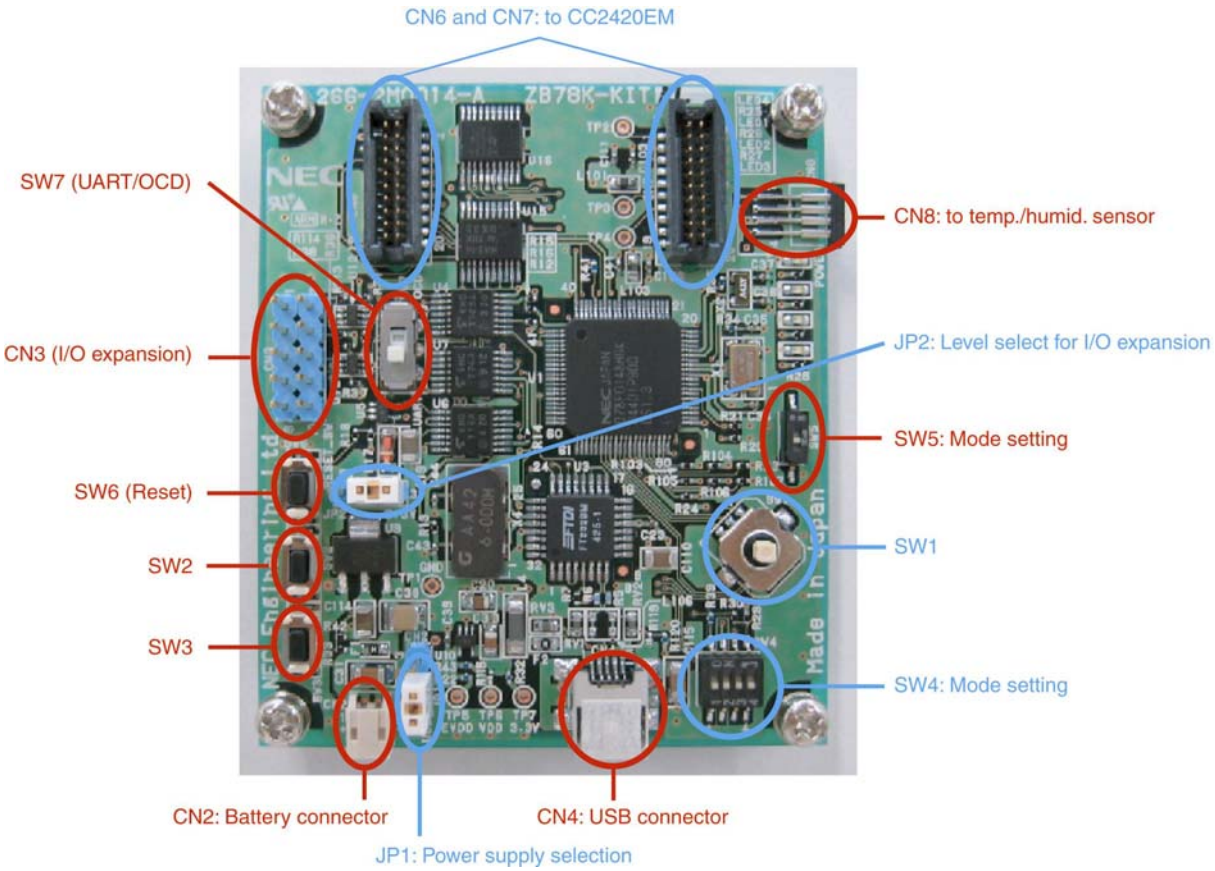
Please replace the battery with a new one, if the voltage level goes down to 6.5V.
Below the voltage level of 6.5V, functions of the board are not guaranteed.
The battery voltage can be checked at the port P20 as shown below.

Battery Check

Name	MCU Pin	Description
BT_MONI	P20/ANI0	33.8% of the battery output is available at ANI0. For instance, if the battery level is 9 V, the level of the BT_MONI = 0.338×9.0 V = 3.042 V If the battery level is 6.5 V, the level of the BT_MONI = 0.338×6.5 V = 2.197 V

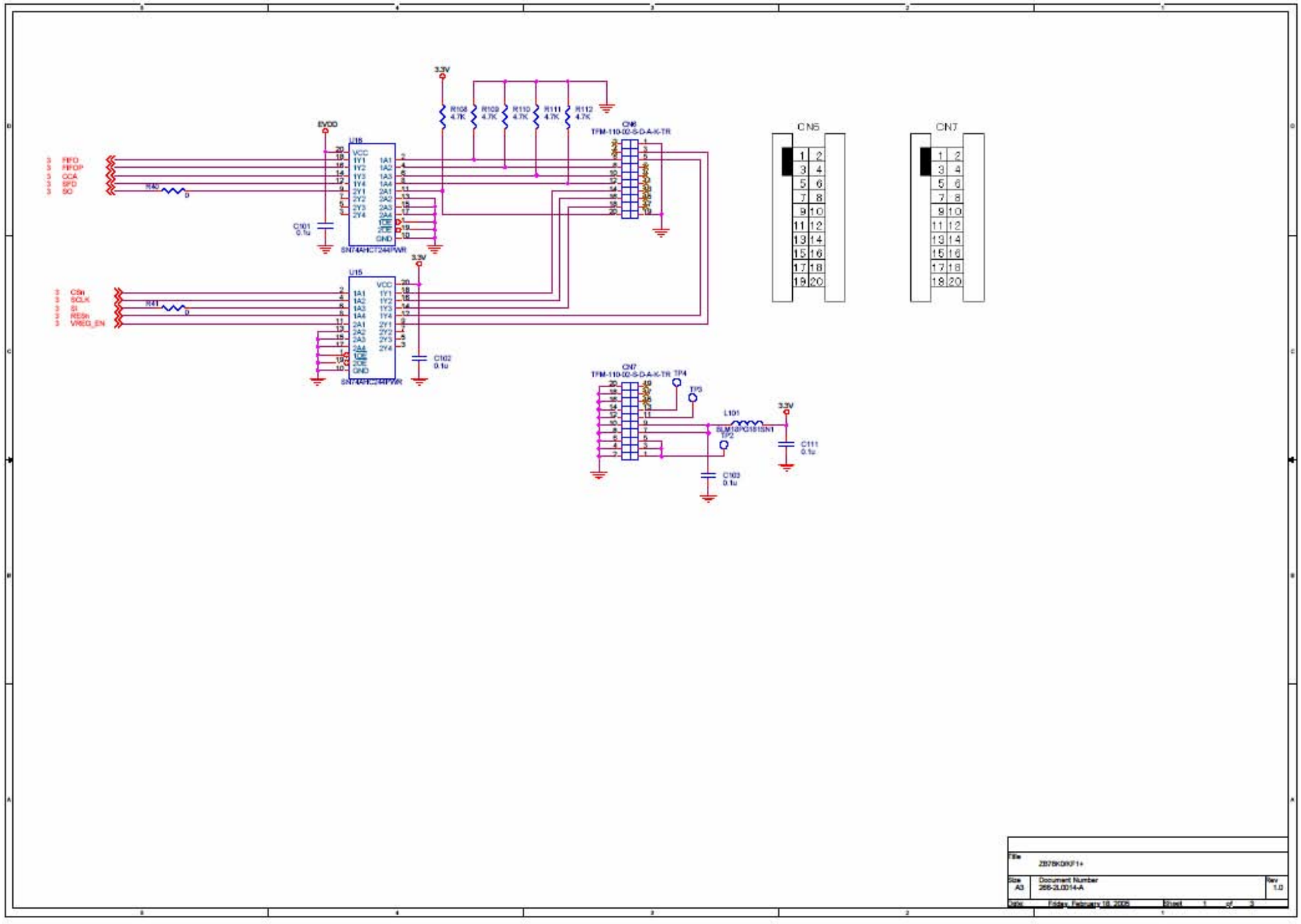
CHAPTER 4 DESIGN DATA

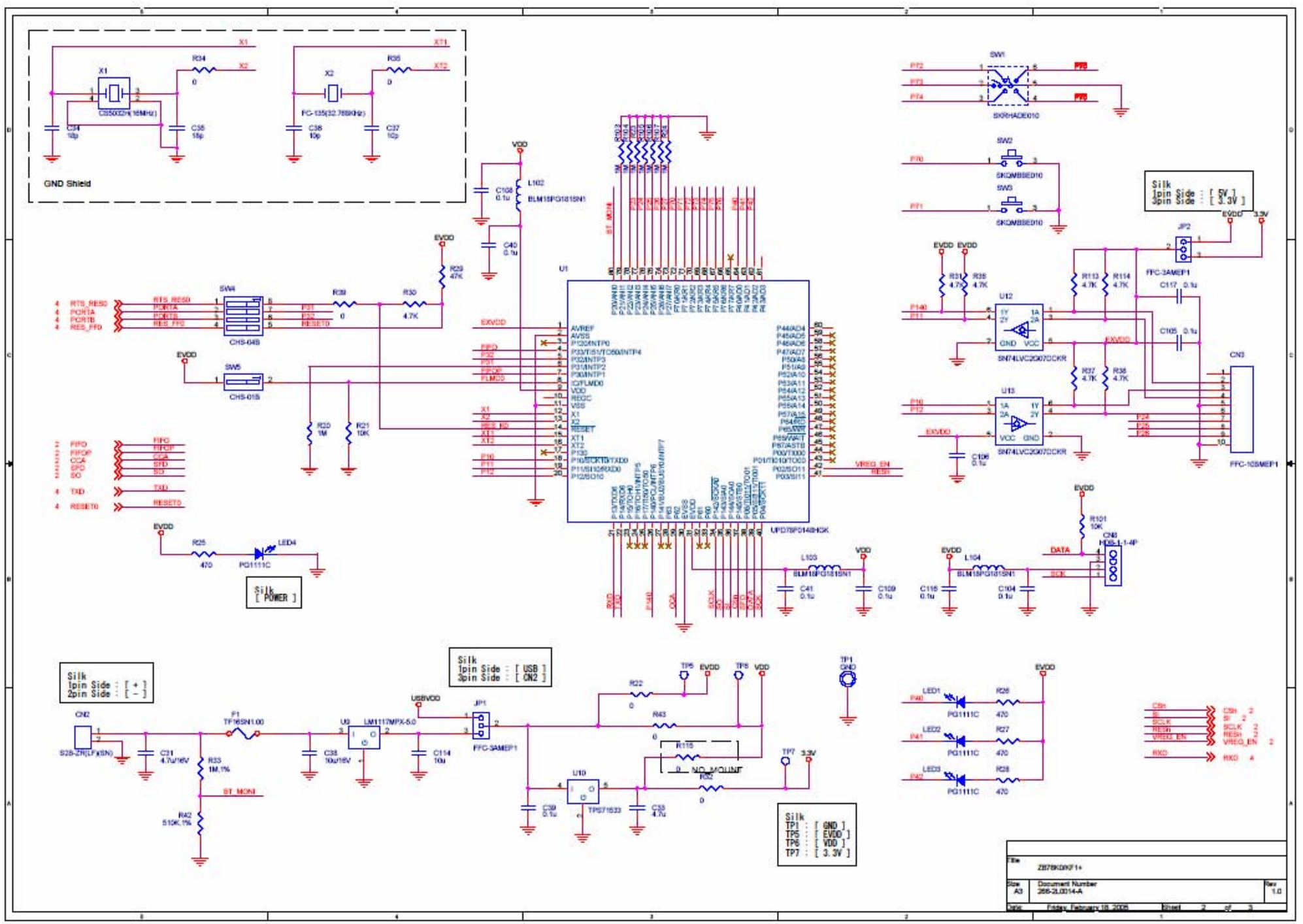
4.1 Parts Layout

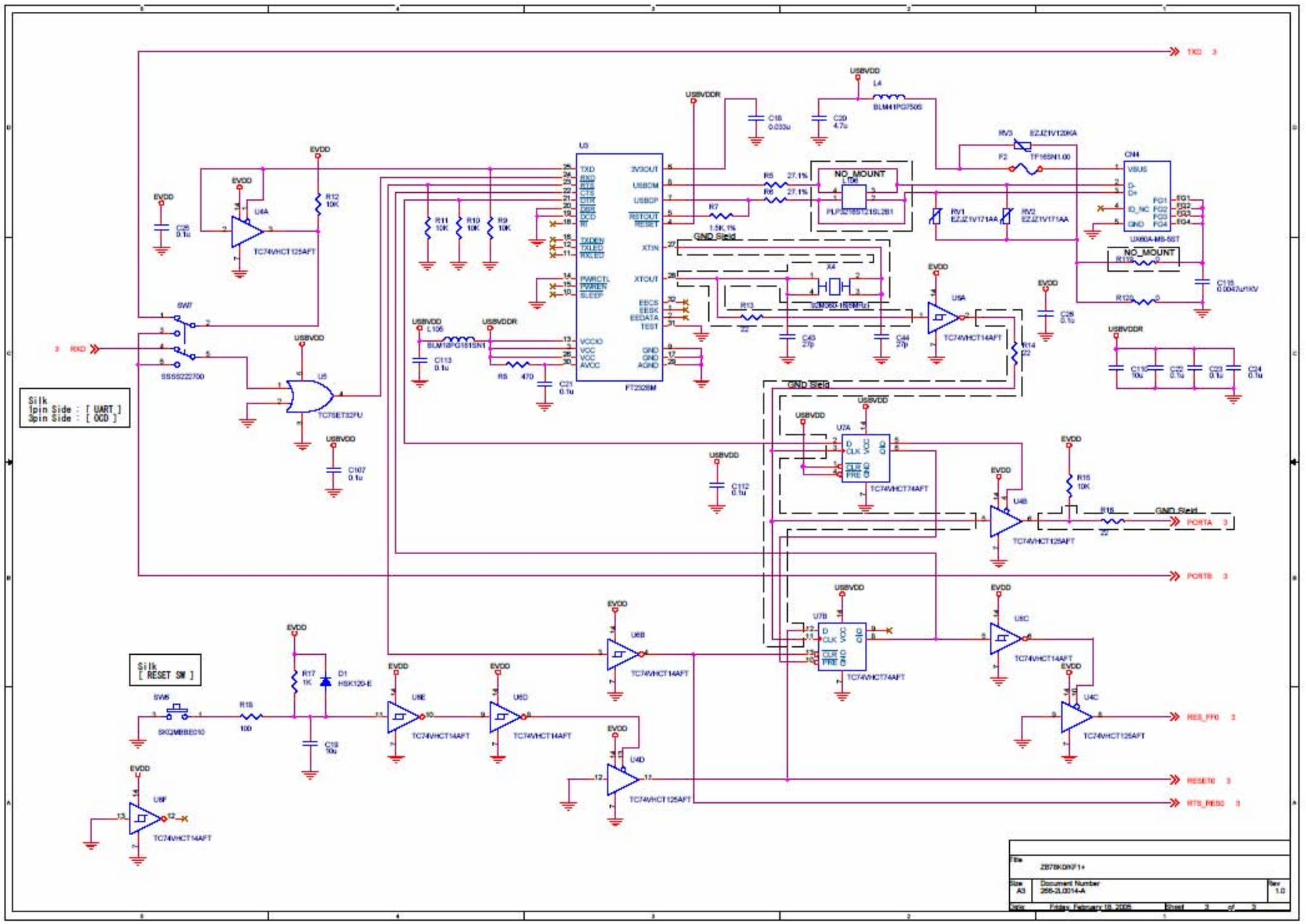


4.2 Connection to CC2420EM

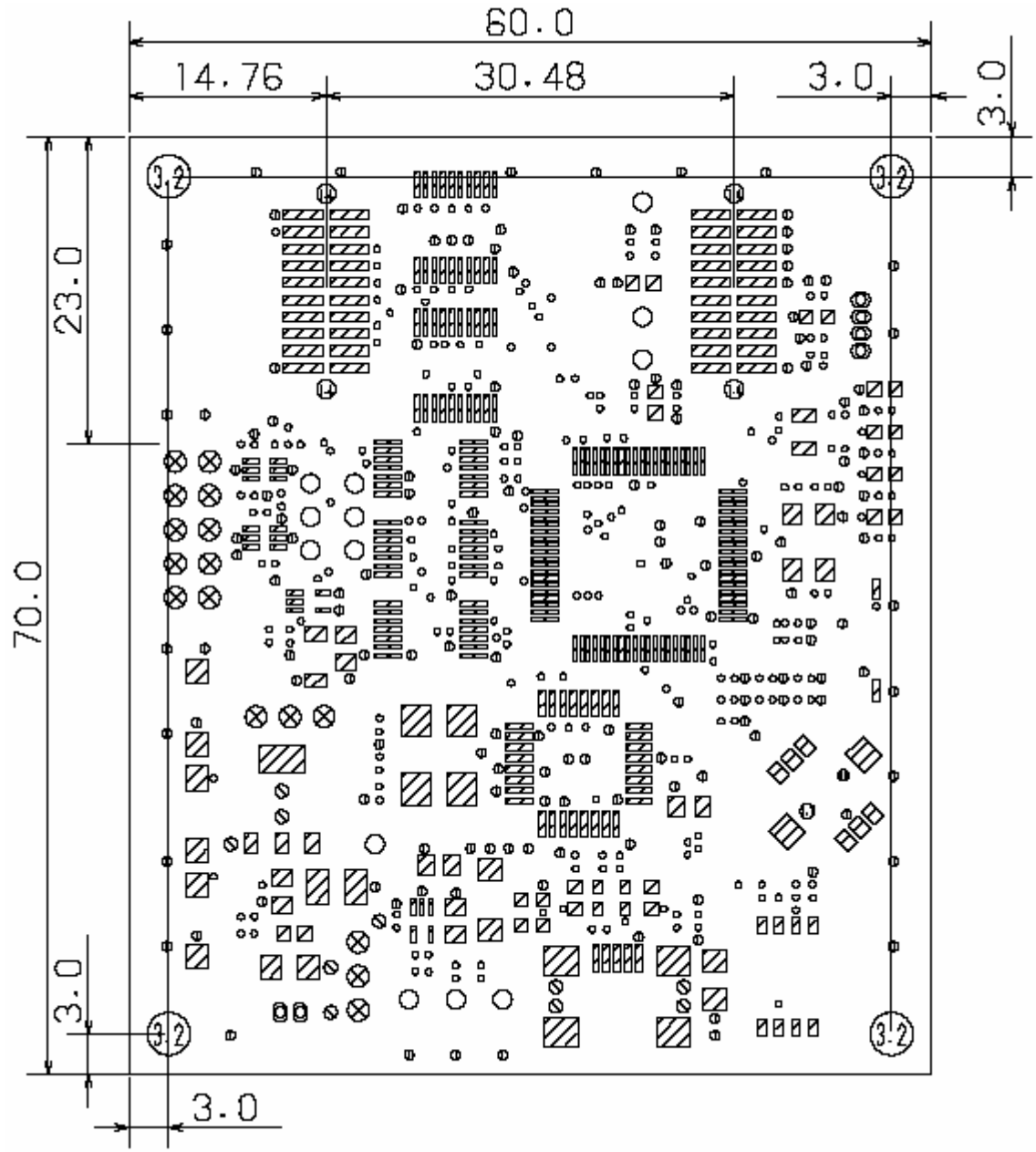
4.3 Circuit Diagram of the MCU Board




GND Shield
X1
X2
XT1
XT2
C34 10p
C35 18p
C38 10p
C37 10p
R34 0
R35 0
CS5002H(16MHz)
FC-135(32.768KHz)
VDD
EVDD
L102 BLM18PG181SN1
C108 0.1u
C40 0.1u
R29 47K
U1
UPD78F0148HGK
SW1
SW2
SW3
SKRHADE010
SKQMBBED10
Silk
1pin Side : [5V]
3pin Side : [3.3V]
JP2
FFC-3AMEP1
U12
U13
SN74LVC2G07DCKR
CN3
FFC-10SMEP1
SW4
CHS-04B
SW5
CHS-01B
R30 4.7K
R38 0
R20 1M
R21 10K
RTS_RESO
PORTA
PORTB
RES_FFO
FIFO
FIFOF
CCA
SFD
SO
TXD
RESET0
R25 470
LED4
PG1111C
Silk
[POWER]
R101 10K
CN8
MDS-1-1-4P
DATA
SCK
L103 BLM18PG181SN1
L104 BLM18PG181SN1
C41 0.1u
C109 0.1u
C115 0.1u
C104 0.1u
Silk
1pin Side : [+]
2pin Side : [-]
CN2
S2B-ZR(LF)(SN)
F1 TF16SN1.00
C31 4.7u/16V
R33 1M,1%
R42 510K,1%
ST_MON
U9 LM1117MPX-5.0
USBVDD
C38 10u/16V
C114 10u
JP1
FFC-5AMEP1
Silk
1pin Side : [USB]
3pin Side : [CN2]
R22 0
R43 0
R115 0 NO_MOUNT
R52 0
U10
TPS71633
C39 0.1u
C33 4.7u
TP1 GND
TP5 EVDD
TP6 VDD
TP7 3.3V
Silk
TP1 : [GND]
TP5 : [EVDD]
TP6 : [VDD]
TP7 : [3.3V]
LED1
LED2
LED3
R26 470
R27 470
R28 470
CSn
SI
SCLK
RESn
VREQ_EN
RXD
Z8F6403NF1+
Document Number
258-2L0014-A
Rev 1.0
Friday, February 18, 2005
Sheet 2 of 3

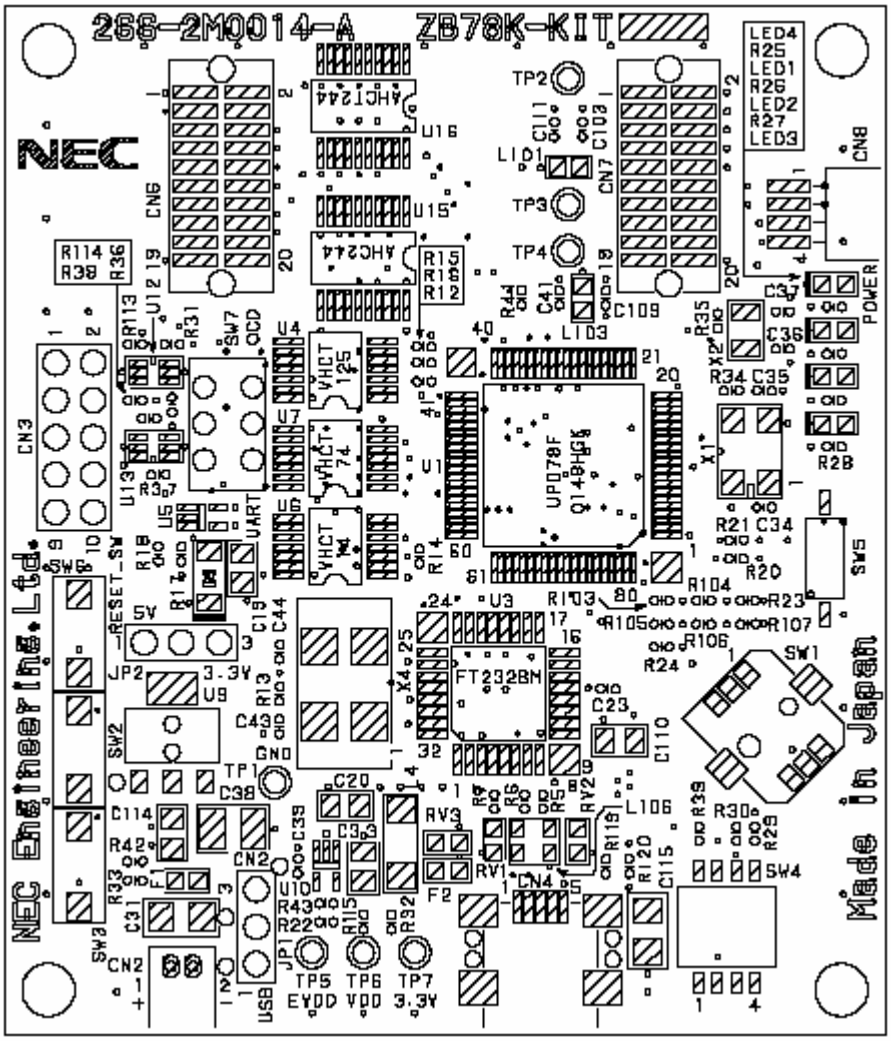

TXD 3
RXD 3
PORTA 3
PORTB 3
RES_FPD 3
RESETD 3
RTS_RESD 3
USBVDD
USBVDDR
EVDD
GND Sield
NO_MOUNT
Silk
3pin Side : [UART]
9pin Side : [OCD]
Silk
[RESET SW]
TC74VHCT125AFT
TC74VHCT14AFT
TC74VHCT74AFT
TC7SET32FU
FT2232M
SSSS222700
SKQMBBE010
UX60A-MB-5ST
TF165N1.00
BLM41PG750S
BLM18PG151SN1
PLP3216S121SL2B1
SCM060-18.000Mz
Silk
Sin Side : [UART]
9pin Side : [OCD]
Z878KDNF1+
Document Number
266-2L0014-A
Rev
1.0
Friday, February 18, 2005
Sheet 3 of 3

4.4 Dimension of the MCU Board

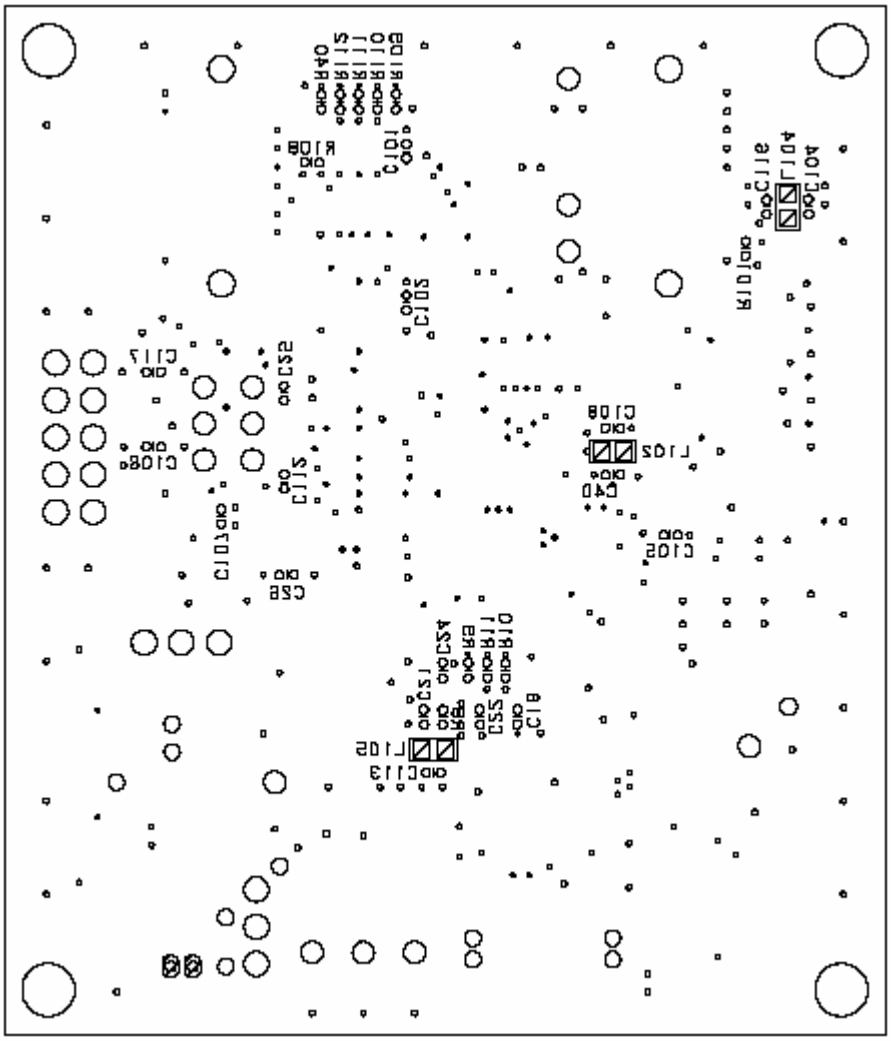


4.5 Pattern Layout of the MCU Board

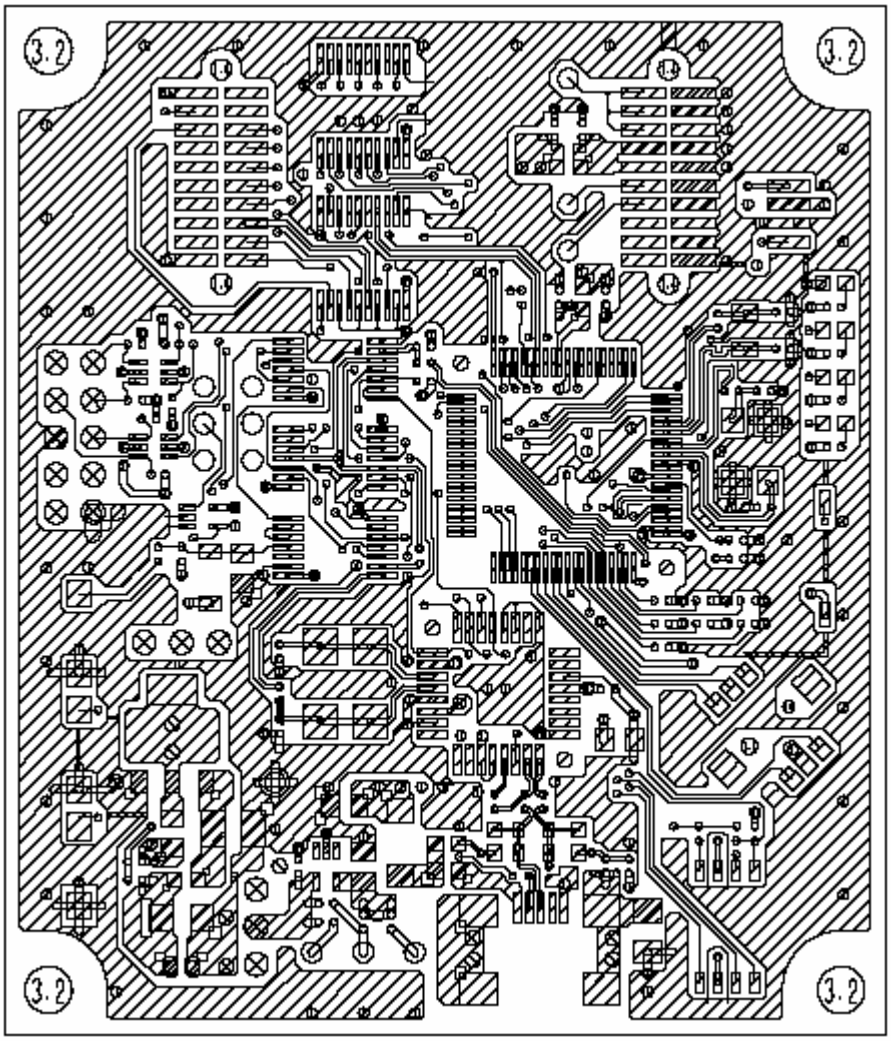
4.5.1 Top Side



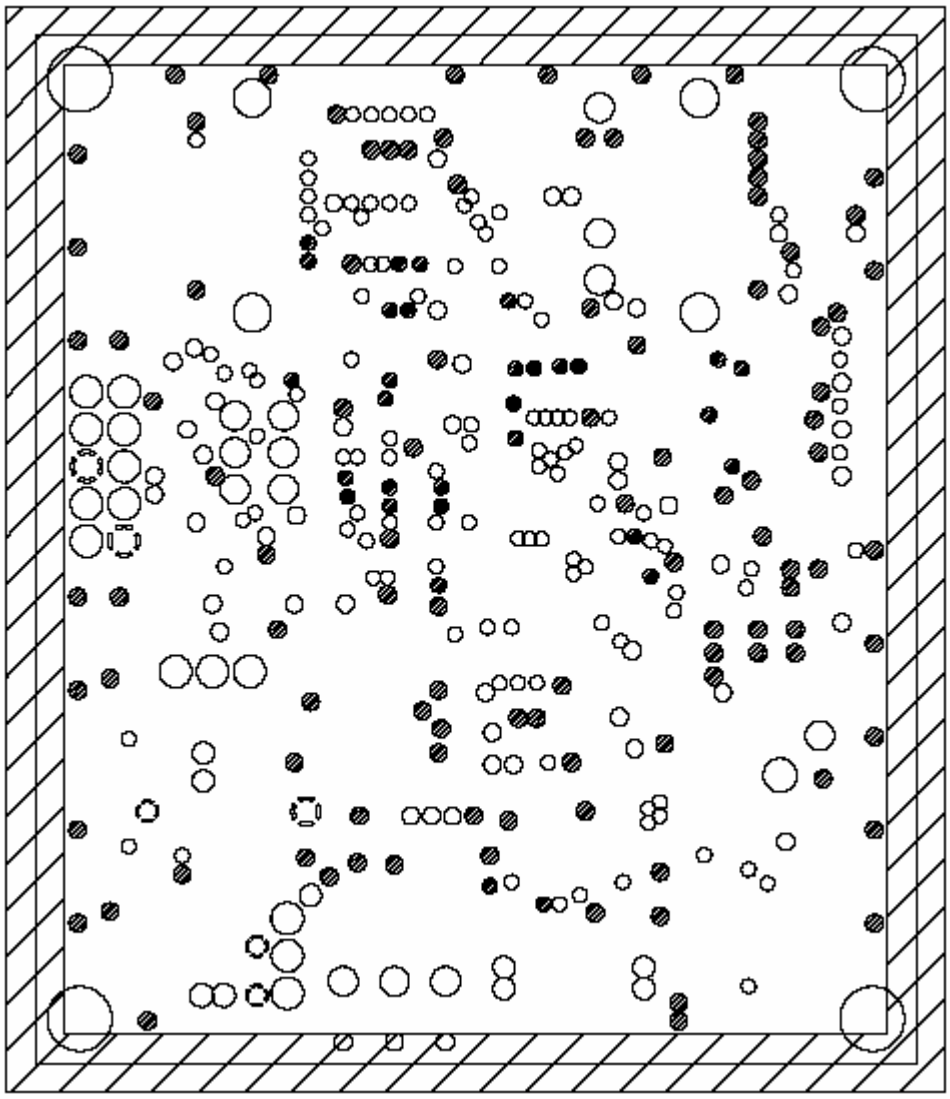
4.5.2 Bottom Side



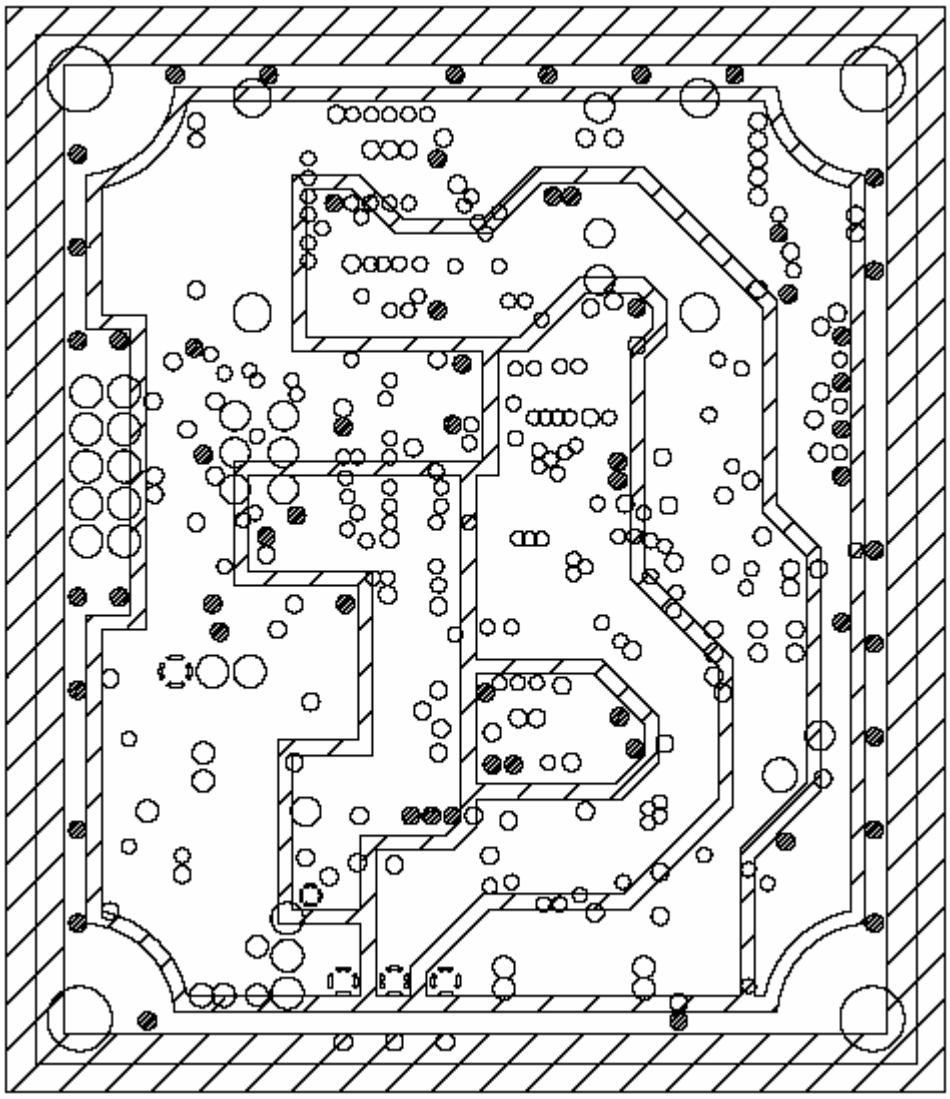
4.5.3 First intermediate layer



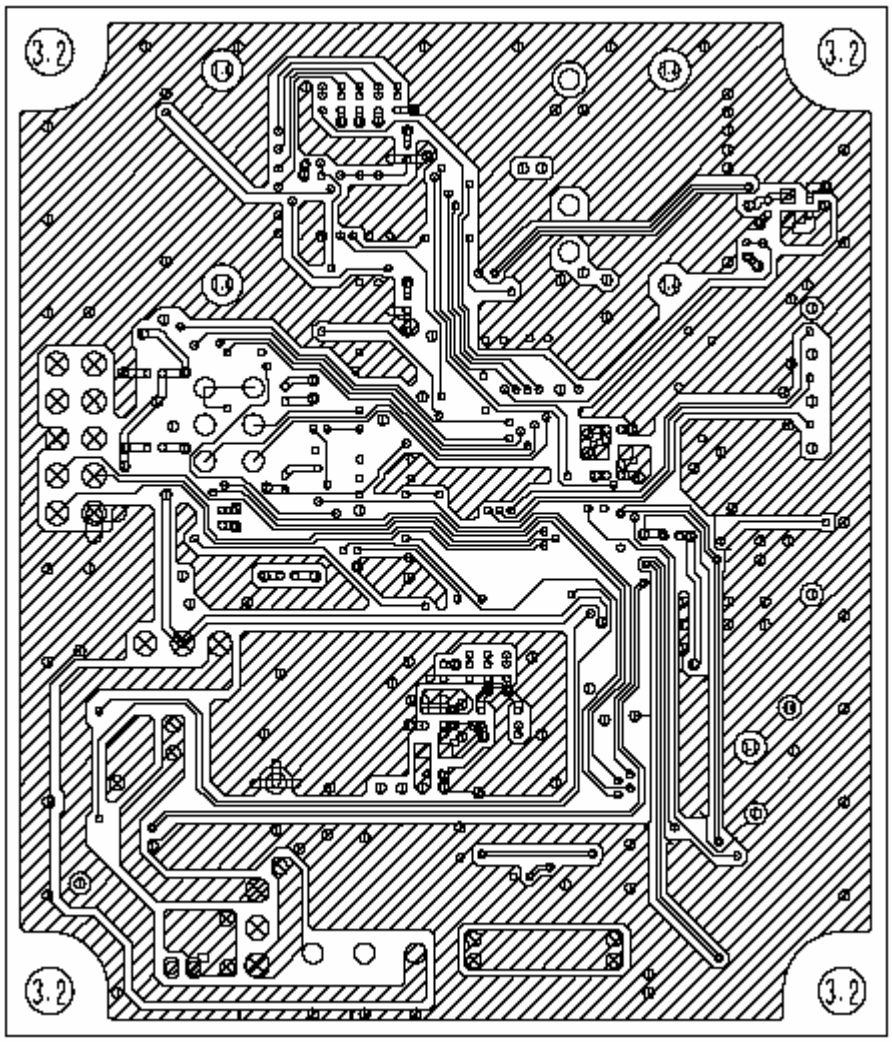
4.5.4 Second intermediate layer



4.5.5 Third intermediate layer



4.5.6 Fourth intermediate layer



4.6 BOM List

No.	Quantity	Location	Item	Manufacturer
1	1	CN2	S2B-ZR(LF)(SN)	JST
2	1	CN3	FFC-10BMEP1	HONDA CONNECTORS
3	1	CN4	UX60A-MB-5ST	HRS
4	2	CN7,CN6	TFM-110-02-S-D-A-K-TR	SAMTEC
5	1	CN8	HDB-1-1-4P	MAC8
6	1	C18	0.033u	
7	3	C19,C110,C114	10u	
8	2	C33,C20	4.7u	
9	23	C21,C22,C23,C24,C25,C26,	0.1u	
		C39,C40,C41,C101,C102,		
		C103,C104,C105,C106,C107,		
		C108,C109,C111,C112,C113,		
		C116,C117		
10	1	C31	4.7u/16V	
11	2	C35,C34	18p	
12	2	C36,C37	10p	
13	1	C38	10u/16V	
14	2	C43,C44	27p	
15	1	C115	0.0047u/1KV	
16	1	D1	HSK120-E	RENESAS
17	2	F1,F2	TF16SN1.00	KOA
18	2	JP1,JP2	FFC-3AMEP1	HONDA CONNECTORS
19	4	LED1,LED2,LED3,LED4	PG1111C	STANLEY ELECTRIC
20	1	L4	BLM41PG750S	MURATA
21	5	L101,L102,L103,L104,L105	BLM18PG181SN1	MURATA
22	1	L106	PLP3216S121SL2B1	MURATA
23	2	RV2,RV1	EZJZ1V171AA	PANASONIC
24	1	RV3	EZJZ1V120KA	PANASONIC
25	2	R5,R6	27.1%	
26	1	R7	1.5K,1%	
27	5	R8,R25,R26,R27,R28	470	
28	7	R9,R10,R11,R12,R15,R21,	10K	
		R101		
29	3	R13,R14,R16	22	
30	1	R17	1K	
31	1	R18	100	
32	8	R20,R23,R24,R103,R104,	1M	
		R105,R106,R107		
33	11	R22,R32,R34,R35,R39,R40,	0	
		R41,R43,R115,R119,R120		
34	12	R30,R31,R36,R37,R38,R108,	4.7K	
		R109,R110,R111,R112,R113,R114		
35	1	R29	47K	
36	1	R33	1M,1%	
37	1	R42	510K,1%	
38	1	SW1	SKRHADE010	ALPS
39	3	SW2,SW3,SW6	SKQMBBE010	ALPS
40	1	SW4	CHS-04B	COPAL
41	1	SW5	CHS-01B	COPAL
42	1	SW7	SSSS222700	ALPS
43	1	U1	UPD78F0148HGK	NEC
44	1	U3	FT232BM	FTDI
45	1	U4	TC74VHCT125AFT	TOSHIBA
46	1	U5	TC7SET32FU	TOSHIBA
47	1	U6	TC74VHCT14AFT	TOSHIBA
48	1	U7	TC74VHCT74AFT	TOSHIBA
49	1	U9	LM1117MPX-5.0	NS
50	1	U10	TPS71533	TI
51	2	U12,U13	SN74LVC2G07DCKR	TI
52	1	U15	SN74AHC244PWR	TI
53	1	U16	SN74AHCT244PWR	TI
54	1	X1	CS5032H(16MHz)	CITIZEN
55	1	X2	FC-135(32.768KHz)	EPSON
56	1	X4	92M060-16(C)6.000MHz	SMI